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(71) Applicant
Norm Pacific Automation Corporation

(Incorporated in Taiwan)

182 Keng-Tzu-Kou, Hsinfong Shiang, Hsinchu Hsien, Taiwan

(72) Inventor
Jia-Ming Shyu

(74) Agent and/or Address for Service
Withers & Rogers
4 Dyer's Buildings, Holborn, London, EC1N 2JT, United Kingdom

(54) **Automatic weather forecasting device**

(57) An automatic weather forecasting device, independently installed or accompanied with another device, such as an air-conditioner, is capable of displaying the current outside weather and forecasting that of the future. There are several sensors mounted outside for measuring weather-related factors such as the temperature, humidity, air pressure, wind speed and luminosity. The sensed data is stored in a memory unit and analysed and compared by a microcomputer for weather forecasting. The microcomputer interpolates predicted values for the weather parameters based on previously sensed and stored values. The results will be displayed on an indoor or outdoor display unit. The device is also capable of self-learning for adaptively correcting the sensing and forecasting errors caused by the installation in a specific place.

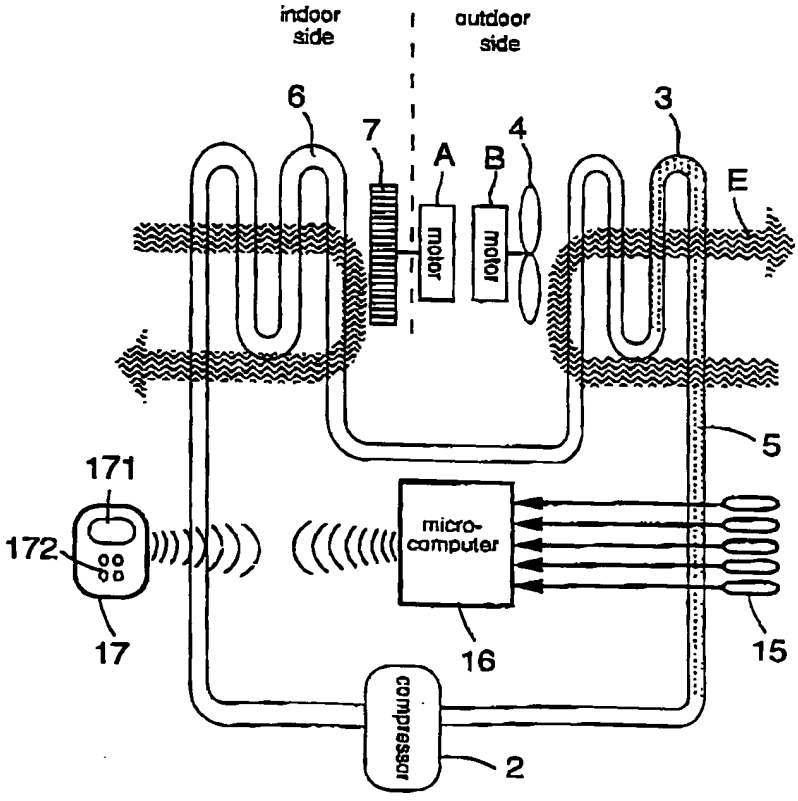

FIG. 1

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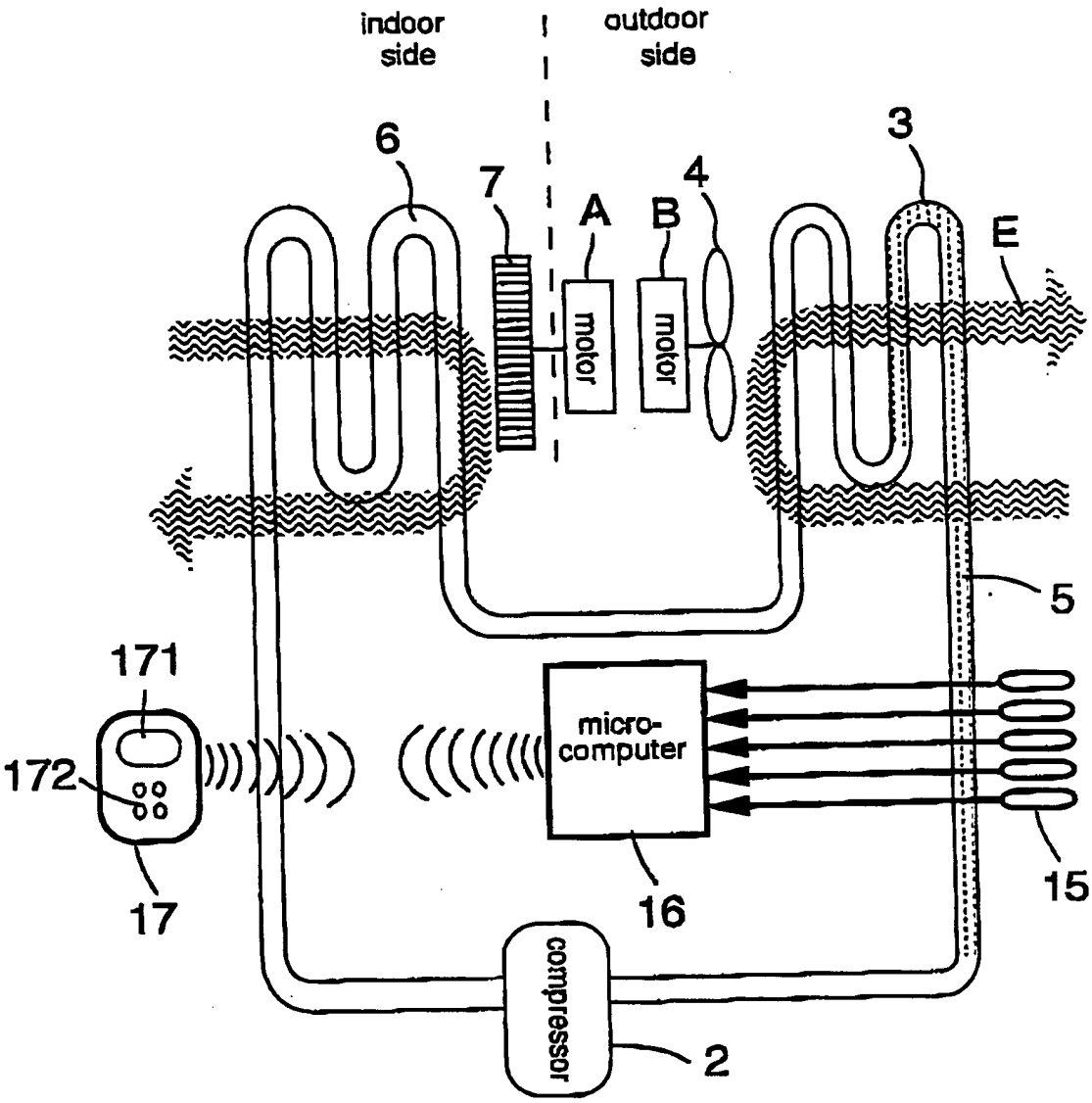
indoor side
outdoor side
6
7
A
B
4
3
E
motor
motor
5
171
172
micro-computer
17
16
15
compressor
2

FIG. 1

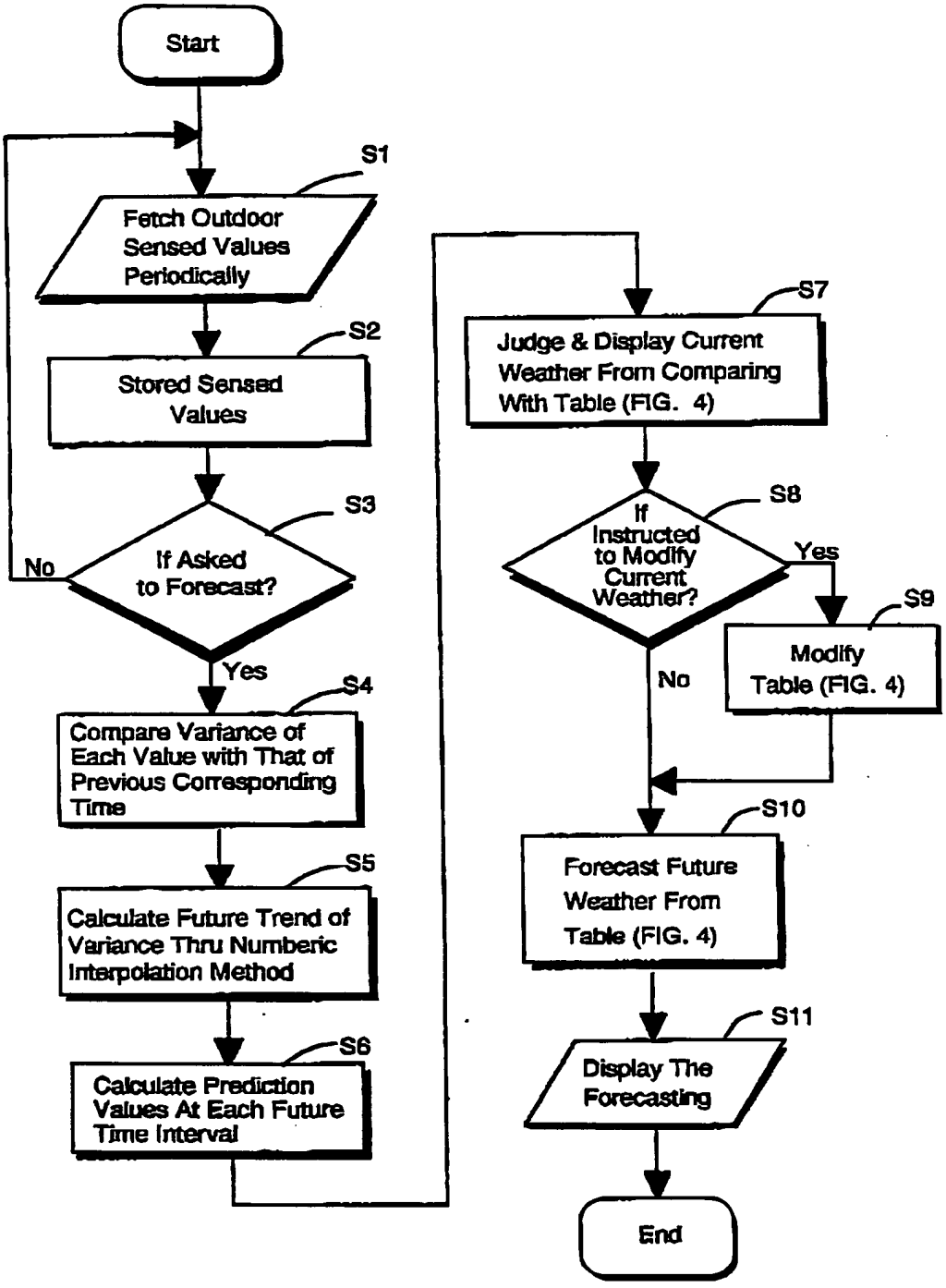
Start
S1
Fetch Outdoor Sensed Values Periodically
S2
Stored Sensed Values
S3
If Asked to Forecast?
No
Yes
S4
Compare Variance of Each Value with That of Previous Corresponding Time
S5
Calculate Future Trend of Variance Thru Numberic Interpolation Method
S6
Calculate Prediction Values At Each Future Time Interval
S7
Judge & Display Current Weather From Comparing With Table (FIG. 4)
S8
If Instructed to Modify Current Weather?
Yes
No
S9
Modify Table (FIG. 4)
S10
Forecast Future Weather From Table (FIG. 4)
S11
Display The Forecasting
End

FIG. 2

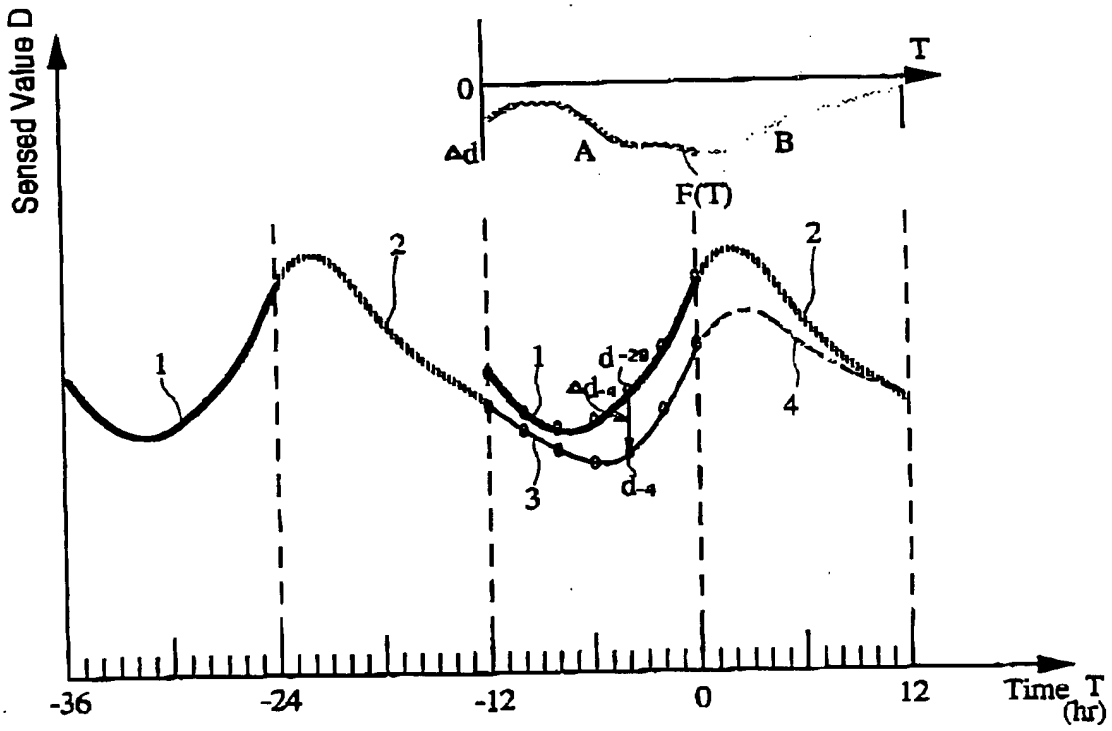
Sensed Value D
T
0
Δd
A
B
F(T)
1
2
2
1
3
4
d-28
Δd-4
d-4
-36
-24
-12
0
12
Time T
(hr)

FIG. 3

Table 4/4

Weather-Related Factors and Weather Condition

factor / weather	temperature dew point t, τ ℃	variance of temperature Δt ℃	relative humidity φ %	variance of relative humidity $\Delta\varphi$ %	absolute humidity x g/kg	air pressure p mb	variance of air pressure Δp mb	wind speed v m/s	luminosity L Lux
fair	$t > \tau$	> -1	< 70	$\leqq 0$	NR	$\geqq p_o$	$\geqq 0$	< 1	$\geqq L_o$
cloud	$t < \tau$	> -2 < 2	< 85	$\geqq 0$	NR	$p_o \pm 10$	$\neq 0$	> 0.5	$= L_o$
cloudy	$t > \tau$	$\leqq 0$	< 90	$\geqq 0$	NR	$< p_o$	$\neq 0$	NR	$< L_o$
mist	$t < \tau$	$\leqq 0$	> 95	$\geqq 0$	> 3.7	$> p_o$	$\neq 0$	< 3	$< L_o$
rainy	$t > 0$ $t \leqq \tau$	< 0	> 95	$\geqq 0$	> 3.7	$< p_o$	< 0	NR	$< L_o$
snowy	$t < 0$ $t \leqq \tau$	> -2 < 2	> 95	$\geqq 0$	< 3.7	$< p_o$	< 0	NR	$< L_o$
windy	NR	$\leqq 0$	NR	$\neq 0$	NR	$< p_o$	< 0	< 3	NR
dew	$t > 7$ $t \leqq \tau$	< 0	> 90	> 0	> 3.7	$> p_o$	> 0	< 1	$> L_o$
frost	$t < 7$ $t \leqq \tau$	< 0	> 90	> 0	< 6.2	$> p_o$	> 0	< 1	$> L_o$
remarks	NR : No Relation			p_o : local standard air pressure			L_o : local standard luminosity that moment		

FIG. 4

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AUTOMATIC WEATHER FORECASTING DEVICE

This invention relates to an automatic weather forecasting device which is capable of displaying current outdoor weather and forecasting that of any specific time interval in the near future and nearby area.

The geographic or topographic difference normally is the main reason causing regional difference of weather. However, a conventional weather forecasting relies on collecting the weather-related factors such as the temperature, humidity, air pressure, wind speed, wind direction, etc. sensed from every weather station in different locations (the distance between each weather station may be far away), or taking an atmospheric clouds distribution map from a plan or a weather satellite, and then analyses, and predicts those data by a computer in the Weather Bureau. Owing to technology progressing, currently, there are computers and other computer-aided equipments adapted in providing more precisely future-weather forecasting in a broader area. Yet, each forecasting area may contain regions comprising several different terrains such as mountains, hills, plains, lakes, streams, ocean, etc. Thereby, it might have several apparently different weather situations in a single forecasting area. In order to adapting to this circumstance, or any possible weather situation on a high-rise building or skyscraper, the weather man has to broadcast with some vague words, such as partly cloudy, sometimes shower or fair, to include a larger variance domain. This kind of weather forecasting may be valid in predicting a swift weather change that affects a large area such as a typhoon, a cold front, etc., however, it is meaningless to local weather in a particular area. And, it can not

provide the weather trend at a specific future period in a specific area.

On the other hand, an air-conditioning environment is generally separated from the outdoor environment, therefore, people who live indoors are usually without knowledge of the outdoor weather.

This present invention is a weather forecasting device providing a function of sensing the outdoor weather-related factors, then analysing and forecasting how the future weather will be. This device can be installed independently or mounted accompanied with other equipment such as an air-conditioner. This present invention can notify the indoor or outdoor users of the current weather condition and its trend. Moreover, if the weather is going to change swiftly, this present invention can give a precaution signal such as a sound alarm, a light flash, etc., in order to notify users to take proper actions in advance.

A practical embodiment of this present invention is to install several sensors at the outdoor side of an air-conditioner for periodically sensing the respective weather-related factors such as outdoor temperature, humidity, air pressure, wind speed, and luminosity, etc. These factors are stored in a memory unit. Then, a microcomputer compares and analyses these stored factors. The local weather condition and its variance, at current and each time interval in the near future, in the location that this device is installed, will thus be predicted and displayed in an indoor display unit.

The construction and functions of the present invention will be apparent from the following description accompanied with the appendant figures, in which:

FIG. 1 is a block diagram illustrating an embodiment of this

invention mounted accompanied with an air-conditioner.

FIG. 2 is a flow chart illustrating the operation of a microcomputer in the present invention .

FIG. 3 is a diagram illustrating a calculation methodology with values sensed previously in predicting future trend.

FIG. 4 is a table illustrating a database of weather-related factors and weather conditions regarding how weather is predicted by an embodiment of this invention.

FIG. 1 is a block diagram illustrating the construction of an embodiment of this invention which is accompanied with a conventional air-conditioner. The air-conditioner in this embodiment comprises: a compressor 2; a condenser 3; an evaporator 6; motor A, B; fan 4, 7; and refrigerant 5 flowing in the tubes; besides, there are several sensors 15 installed at the outdoor side of the air-conditioner for sensing weather-related factors such as the temperature, humidity, air pressure, wind speed and luminosity. (Each sensor is mounted at a suitable position to have more precise sensed value which is not be influenced by the operation of the air-conditioner.)

These values will be sensed periodically, and stored in an unshown memory unit of a microcomputer 16. The microcomputer 16 will then compare the weather-related factors that are sensed in the latest period (e.g. past 12 hrs) with that of the correspondent period in the previous day (e.g. past 36-24 hrs). Through mathematical method, the variance trend of each weather-related factor can be expressed with a time function, which will be used to induce the corresponding variance at each time interval thereafter. By adding this variance to the recorded weather-

factors of the respective periods at previous day, the weather-related factors at some period after this sensing moment (e.g. next 12 hrs) can be derived and predicted. These prediction values will be compared with that of the table (FIG. 4) of weather-related factors and weather condition which is stored as a database in the microcomputer 16, weather condition is then judged. The result will transmit through a wireless or wire-connecting device to a display unit, a speaker(unshown) or a remote controller 17 which may be located indoors or outdoors. The remote controller 17 comprises a display unit 171 and an input key-sets 172; wherein the display unit 171 is used to display the weather forecasting and any other operational message of the air-conditioner; and the input key-sets 172 can be used not only to select required information, but also to input the actual weather condition to the microcomputer 16 as a data in modifying/correcting previous weather-related table which can more precisely forecast the weather thereafter. The forecasting and modifying procedure will be further described as follows.

FIG. 2 is a flow chart illustrating the operation of the microcomputer in this invention. At step S1, the microcomputer 16 (FIG. 1) fetches periodically from each outdoor sensor its respective sensing value (the weather-related factor). At step S2, the memory unit of the microcomputer 16 stores the latest sensed values, and whenever a new record is appended, an oldest one will be deleted automatically to maintain an updated serial record. At step S3, the microcomputer detects if there is any user asking for weather forecasting; if no, then loops back to step S1; if yes, then executes the calculation and judgement procedures, which are step S4 and procedures thereafter. At step S4, the

microcomputer compares the variances of each value sensed at each time interval beginning backwards from the latest record with that from the memory unit of each corresponding interval in a day before, as shown in FIG. 3: on time axis T, it compares each sensed value D (such as temperature, the rest values proceed accordingly) in each time interval in past 12 hours (the curve 3) with that of the period in past 36 hours to past 24 hours (the curve 1), and derives each corresponding difference Δd of each sensed value (such as: Δ_{d-4} is derived from comparing the sensed data d_{-4} and that of d_{-28}). Then at step S5, the difference Δd from each sensed value will be calculated and implied with numeric interpolation method, and induces the Weather Difference Time Function F(T). At step S6, it fills any future time into the Function F(T), a future difference (curve B) of that weather-related factor is obtained, calculates (add or minus) this prediction difference with value (curve 2) of that of the same interval in a day before, a new prediction value (curve 4) corresponding to the same time interval in the near future is implied. Any other weather-related factor follows the same. At step S7: each value sensed currently will be compared with that in the table (As shown in FIG. 4, this table is a reference database adaptable for most general area, as to some special locations or areas, the microcomputer 16 will self-learn and modify this table through an instruction step which will be described below.) of weather-related factors and weather condition, and the current weather condition can then be judged and displayed, and can be checked by the user to see if it consists with the actual weather and treated as a reference to modify the above mentioned table. That is, at step S8, the microcomputer 16 will detect if it is instructed to modify: if user enters

the actual weather condition, then the microcomputer 16 will modify the table (Step S9) with each current sensed and calculated value, then proceed to step 10; if no instruction received, then it goes directly from step S8 to step S10. At step 10, the weather forecast at each time interval in the future can be obtained through comparing each prediction future value (curve 4 of FIG. 3) with that (FIG. 4) of the table. Finally, weather forecasting will be output to the display unit through a wireless or wire-connecting device and displayed.

FIG. 4 is a table illustrating the database of weather-related factors and weather conditions of an embodiment of this invention. The weather-related factors include: temperature and dew point (dew point can be calculated from temperature, relative humidity and air pressure), variance of temperature (the difference of sensed value or predicted value at current interval with that of last interval), relative humidity, variance of relative humidity, absolute humidity, air pressure, difference of air pressure, wind speed (wind strength), luminosity, etc. The weather conditions that can be judged include: fair, cloud, cloudy, mist, rainy, snowy, windy, dew, frost, etc. Examples underneath explain the relationships between weather-related factor and weather condition, so that the judgement procedure described at step 7 and step 10 will be better understood:

Example 1: assuming the weather-related factors that influence current weather or certain interval in the near future are:

1. variance of outdoor temperature ≥ -1 °C

(*that the temperature is getting higher or slightly lower),

2. variance of relative humidity ≤ 0 %

(*that the relative humidity remains unchanged or reduces),

3. variance of air pressure ≥ 0 mb

(*that the air pressure remains unchanged or increases),

4. outdoor relative humidity ≤ 70 %,

5. wind speed < 1 m/sec

(* this value might have a little difference by area, however, it will be modified from self-learning and experience aggregation of this present invention),

6. outdoor temperature > dew point

(*that the vapor in the air can not condense),

7. outdoor air pressure $\geq$ local standard air pressure,

8. outdoor luminosity $\geq$ standard luminosity at that moment

(* that it is very bright outside),

then, comparing each with that of table of weather-related factors and weather condition, it fulfils what the fair shall be, then it is judged as a sunny day.

Example 2: If the weather-related factors at a certain moment are:

1. outdoor temperature variance ≤ 0 °C

(*that it is getting colder or remains unchanged outside),

2. variance of air pressure < 0 mb,

(*that the air pressure is getting lower),

3. relative humidity changes

(* either increases or decreases),

4. outdoor air pressure < local standard air pressure

(*that at that very area, there will be a low pressure region, the surrounding higher-pressure air will flow towards it and become an air-flow),

5. wind speed > 3 m/sec,

then, it will be a windy weather.

Example 3: If,

1. outdoor temperature variance < 0 °C,

(*that it is getting colder),

2. variance of air pressure < 0 mb

(*that the outdoor air pressure is getting lower),

3. variance of relative humidity ≥ 0 %

(*that the relative humidity is increasing or remains unchanged),

4. outdoor temperature ≤ dew point

(*that the vapor in the air is going to condense),

5. outdoor temperature > 0 °C

(*that the condensed vapor will not be solidified),

6. relative humidity > 95 %,

7. absolute humidity > 3.7 g/kg,

8. outdoor air pressure < local standard air pressure,

9. outdoor luminosity < local standard luminosity at that moment

(*that it is rather dark),

then, it is judged as a rainy day.

At the above described embodiment, all the calculation of the prediction and its forecasting are proceeded by the user's command (step S3), in fact, alternatively, the present invention can periodically calculate values automatically (In that case, step 3 at FIG. 2 will be moved between step 6 and step 7.), or after calculation of the prediction value, finds that the prediction of the sensed value or its variance is larger than a certain domain, i.e., it is predicted that there will be a swiftly weather change (such as a typhoon, wind, storm, cold front, great humidity, a heat wave, etc.), this invention will automatically give a precaution signal such as a sound or verbal alarm, a flash light, etc. in order to notify the user to pay attention to.

As described above, this present invention can certainly forecast the weather automatically, and it can forecast the local weather or its variance at present or any specific time interval in the near future. Moreover, the forecasting in this area can communicate through digital transmission network by a wire or wireless device to other weather forecasting device, and through the on-line data transmission, better judges and predicts between each area the weather differences and its variances to time, thus, a forecast for a broader area is fulfilled. Besides, its display unit can be installed outside the room for public use.

Although the invention is described with respect to a preferred embodiment, modifications thereto will be apparent to those skilled in the art. Therefore, the scope of the invention is to be determined by reference to the claims which follow only. For example, a weather forecasting device constructed independently is still under the claims.

CLAIMS

1. An automatic weather forecasting device, comprising:

at least a group of sensors, for periodically sensing the outdoor temperature, humidity, air pressure, wind speed, and luminosity and generating corresponding values;

a microcomputer with a memory unit, for storing said sensed values and keeping several latest records of said sensed values, calculating prediction values of weather-related factors, judging possible weather condition and forecasting local weather and its variance at that moment and any time interval in the near future; and

a display unit, for displaying said weather condition by at least one of sound, light, figures, or words; wherein, said microcomputer executes the following procedures:

a. calculating separately the difference of current sensed values with sensed values of corresponding interval a day before, and getting respective current differential values;

b. predicting corresponding differential values in each future time interval by a numeric interpolation method through said current differential values;

c. calculating prediction values in each future time interval through addition or deduction of each said future differential values with corresponding sensed values a day before; and

d. comparing and judging said prediction values with a database of weather-related factors and weather conditions which is stored in said microcomputer, and getting said forecasted weather condition at each time interval.

2. A device as claim 1, in which said database of weather-related factors and weather conditions comprises: relationships of factors of temperature, dew point, variance of temperature, relative humidity, variance of relative humidity, absolute humidity, air pressure, variance of air pressure, wind speed, luminosity; and weather conditions of fair, cloud, cloudy, mist, rainy, snowy, windy, dew, and frost.

3. A device as claim 1, in which said microcomputer comprises an input device, to be used by users for inputting actual weather condition which will be compared by said microcomputer with said forecasted weather, and treated as a reference to modify said database.

4. A device as claim 3, in which at least one of said display unit and said input device is located separately at another location and communicated with said device through wireless or wire connection means.

5. A device as claim 1, in which said microcomputer executes periodically said calculating and predicting procedures, and while sensing or predicting any swift change of said weather-related factors, will give a corresponding warning signal through said display unit automatically.

6. An automatic weather forecasting device, substantially as hereinbefore described with reference to the drawings.